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SUPPLEMENTAL REPORT ON MICROWAVE SYSTEMS ACCEPTANCE TESTS

December, 1953

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[redacted]

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WASHINGTON, D. C.

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SUPPLEMENTAL REPORT ON MICROWAVE SYSTEMS ACCEPTANCE TESTS

This report supplements an earlier report entitled "Description of Microwave System Acceptance Tests" dated December 10, 1953 which covered acceptance tests on Divisions 1 through 3 of the microwave system. This supplemental report will describe acceptance tests with respect to Division 4, the final division of the system.

The tests conducted on Division 4 were similar in nature to those conducted on Divisions 1 through 3. They consisted in general of circuit performance tests to determine the overall suitability of the circuits and equipment performance tests to determine that the equipment is operating properly and reliably. Particular attention was given to the teletype circuits of Division 4 because of certain questions raised with respect to the teletype circuits of Divisions 1 through 3.

As a general conclusion, the tests on Division 4 indicate that the equipment is working satisfactorily and with a performance equal to or better than that found with respect to Divisions 1 through 3. However, the one question raised with respect to teletype equipment in Divisions 1 through 3 also pertains to equipment in Division 4. There is a need for determining the reason for a considerable variation in the performance of teletype circuits.

All teletype circuits in Division 4 were tested. In general, it was found, as with the other divisions, that the teletype equipment is capable of operating satisfactorily. However, a few components were found defective, and certain circuits have a poorer performance than others to the extent that satisfactory operation is not always

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practicable. It appears that whereas the percentage of circuits which are low in performance is relatively small, there are enough to be a matter for concern. Under the circumstances the equipment as installed cannot be considered 100% satisfactory.

On the basis of the tests conducted on equipment in Division 4, as well as those conducted on equipment in Divisions 1 through 3, it appears reasonable to conclude that the variation in performance of teletype circuits results from a production variation in the characteristics of circuits, filters, and relays in the audio frequency carrier equipment. Since no adjustments exist in these circuits, the equipment must be used as manufactured. In some circuits it appears that production tolerances of the components add favorably whereas in other circuits they add unfavorably. In certain cases the tolerances add in such an unfavorable manner that the circuit is not satisfactory.

Whereas the limited tests conducted indicate that the effect of a particular "poor" component is more detrimental in one circuit than in another, no determination has yet been made as to whether the fundamental difficulty is an excessive variation from design objectives in a particular component or the result of the unfavorable accumulation of reasonable variations in a number of components in a particular circuit.

As a result of the tests on Divisions 1 through 3, the opinion was expressed that the variation in teletype performance may result principally or wholly from a variation in Sigma relays and that some variation in Sigma relays may have resulted in those divisions from polarizing of the relays by current flow in them over the period of months

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that the equipment was turned on but not in use. The tests on Division 4 appear to substantiate the opinion that Sigma relays are affected by polarizing. However, the tests on Division 4 indicate more significantly that the variation in teletype circuits is the result of variations in other circuit components as well as and including the Sigma relays. As a matter of fact, the tests of Division 4 showed a high degree of standardization to exist in the Sigma relays which had been recently installed. Practically all the new relays in Division 4 showed relatively little decrease in range of a circuit which had good quality otherwise.

As an overall conclusion it appears appropriate to find that fundamentally the teletype equipment in Divisions 1 through 4 is acceptable and capable of providing high quality performance. However, there is a need for determining with particularity the number of circuits in the system which have low performance characteristics, and with respect to these, there is a need for determining whether or not performance can be improved by simply substituting components from one circuit to another. If this cannot be done without exhaustive and unreasonable substitution, a determination should be made by testing of those components which have characteristics appreciably different from the design objective and arrangements made with the manufacturer for replacement. Acceptance of the teletype equipment should be predicated upon an agreement with the manufacturer of a satisfactory procedure for exchanging components as necessary to bring the poor circuits up to satisfactory performance standards. Experience with the system indicates that a good circuit may be considered as one which provides a range of 60 or more when used with teletype

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machines having machine ranges of 80. It is suggested that this figure be established as the criteria for a good circuit.

Respectfully submitted,

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December 31, 1953
Appendices

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APPENDIX I - SUMMARY OF DATA ON VOICE CIRCUITS - DIVISION 4

A. Diagrams showing patching arrangements for voice circuit tests

Voice circuit performance tests on Division 4 were made in two parts, (1) a check of circuits between D and L by testing at [redacted] and (2) a test of circuit performance of the entire division, that is, path L-M and D-L by testing from [redacted] 25X1 25X1

The patching arrangement used for tests conducted at [redacted] is shown below: 25X1

Voice Channel #	Originating Station - [redacted]	End Station - [redacted] 25X1
6	X	X
7	X	X
8	X	X
9		X
10 (AFC)		
11 (AFC)		

The patching arrangement used for tests conducted at [redacted] is shown below: 25X1

Voice Channel #	Originating Station - [redacted] 25X1	Intermediate Station -	End Station -
6	X		X
7	X		X
8	X		X
9	X		X
10 (AFC)			
11 (AFC)			

The patching shown above was supplemented by patches made at [redacted] at the time of the tests. 25X1

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APPENDIX I (Continued)

B. Voice circuit performance tests

All quantitative voice performance tests were made using a 1000 cycle test tone input signal of 0 dbm and measured at the output of a voice terminal on a 2-wire basis across a 500 ohm load resistor. A 300-3500 band pass filter was inserted between the output of the voice terminal and the 500 ohm load. In addition, all circuits were checked qualitatively by talking and ringing.

For tests conducted at [redacted] 25X1

Input at (ch)	Output at (ch)	# of voice patchs	# of RF paths	Signal output for 0 dbm input	Noise output for no input	Signal Noise
6	9	3	4	-2.5 dbm	-57 dbm	54.5 db
9	6	3	4	-4 dbm	-58 dbm	54 db

For tests conducted at [redacted] 25X1

Input at (ch)	Output at (ch)	# of voice patchs	# of RF paths	Signal output for 0 dbm input	Noise output for no input	Signal Noise
7 to M	6	1	2	-15 dbm	-60.5 dbm	59 db
6 from M	7	1	2	-2 dbm	-54 dbm	52 db
7 to M*	6					
6 to D	7	5	6	-7 dbm	-60 dbm	53 db
8 to D	9					
9 to D	8					
7 to D	6	5	6	-6 dbm	-54 dbm	48 db
6 to M	7					
9 to M	8	1	2	-2.5 dbm	-60.5 dbm	58 db
8 to M	9	1	2	-2 dbm	-61 dbm	59 db

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APPENDIX I (Continued)

B. Voice circuit performance tests (continued)

For tests conducted at [redacted] 25X1

Input at (ch)	Output at (ch)	# of voice patchs	# of RF paths	Signal output for 0 dbm input	Noise output for no input	Signal / Noise
9 to M	8					25X1
7 to M	6	7	8	-8 dbm	-60 dbm	52 db
6 to D	7					
8 to D	9					
9 to D	8					
7 to D	6	7	8	-7 dbm	-56 dbm	49 db
6 to M	7					
8 to M	9					

*This circuit and some of those which follow are loops. In this case, the signal is inserted on Ch. 7 to M and the output measured on Ch. 9 from D with the other circuits patched as indicated.

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APPENDIX II - (Continued)

A. 3. Local loop tests of variation in performance of transmitters

To determine the variation in transmitters a comparison of circuit performance was made using first a simplex transmitter feeding directly into the appropriate duplex receiver and then using a duplex transmitter feeding directly with the same duplex receiver.

Receiver	Range with simplex transmitter	Range with duplex transmitter
13*	75 (100-25)	85 (105-20)
14	65 (95-30)	70 (95-25)
16	70 (105-35)	80 (105-25)
17	60 (100-40)	65 (100-35)
18	75 (95-20)	80 (100-20)

*Tubes were swapped between transmitters to see if these have any appreciable effect. It was found that there was small or negligible change in range resulting from substitution of tubes.

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APPENDIX II - (Continued)

A. 4. Tests of variation in performance of Sigma relays

This test was conducted by numbering an assortment of Sigma relays and trying each one in turn in the same channel. The test was conducted using duplex Channel 13 and then repeated using duplex Channel 17.

Sigma relay #	Range using duplex Channel 13	Range using duplex Channel 17
13 L	85 (105-20)	80 (100-20)
15 L (This relay was considered bad yesterday)	80 (100-20)	75 (100-25)
14 L	80 (100-20)	80 (100-20)
16 L	80 (100-20)	80 (100-20)
17 L	65 (95-30)	65 (100-35)
18 L	75 (100-25)	70 (100-30)
15 J	This relay no good	
11 J	75 (95-20)	80 (100-20)
12 J	80 (100-20)	
14 J	80 (100-20)	
13 J	75 (100-25)	
9 J	65 (105-40)	60 (105-45)
5 J	80 (100-20)	
6 J	75 (100-25)	75 (100-25)
7 J	80 (100-20)	
8 J	80 (100-20)	

Note: It will be noted that the variation in range performance using Channel 13 and using Channel 17 is the same and depends upon the particular Sigma relay that is used.

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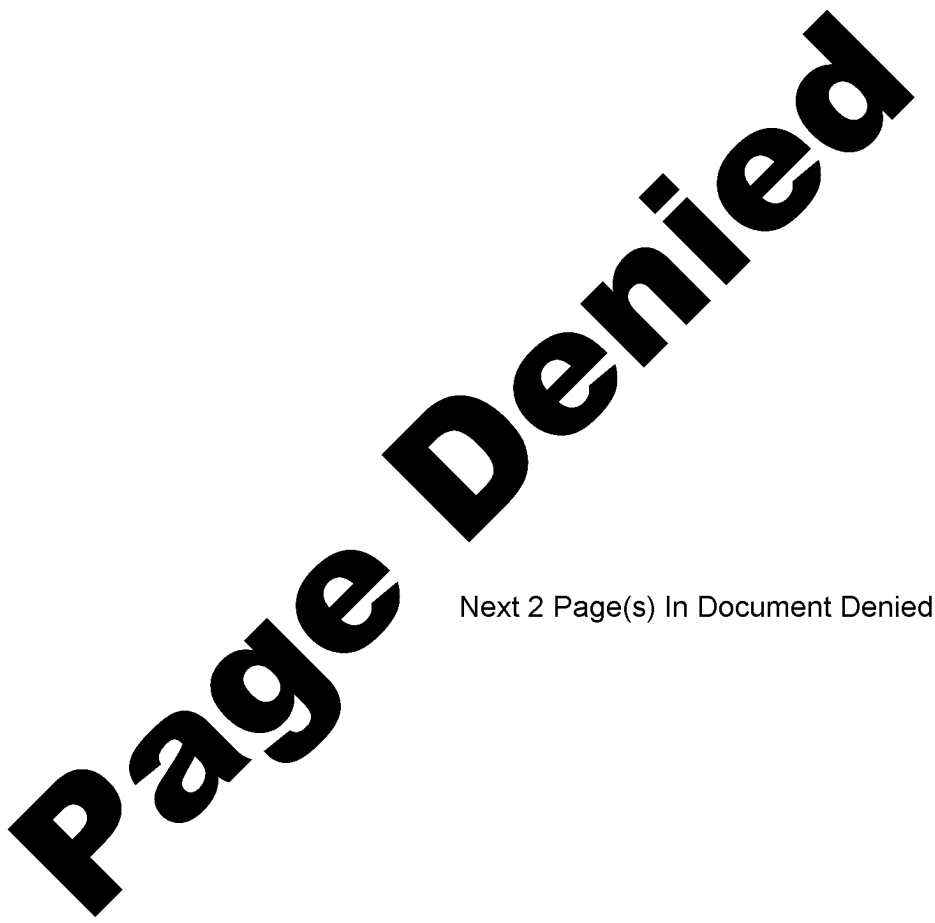

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APPENDIX II (Continued)

B. (Continued)

Channel #	Range
18 duplex	65 (105-40)
17 duplex	65 (105-40)
16 duplex	40 (105-65)
15 duplex	55 (95-40)

*With respect to Channel 18, considerable checking was necessary. Finally it was found by substituting a discriminator circuit from Channel 18 duplex that this circuit could be brought up to a range of 50 (105-55). The effect of placing the discriminator from Channel 18 simplex in Channel 18 duplex was to reduce the range of the duplex circuit from 65 (105-40) to 45 (105-60). This would indicate that the Channel 18 simplex discriminator is probably mis-aligned.

**An attempt was made to improve the range of Channel 5 simplex by changing relays and tubes, etc. The best range obtained was that using the relay from Circuit 7. In this way a range of 40 (95-55) was obtained as compared with the value shown 30 (90-60) under original condition of operation.

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APPENDIX III - (Continued)

B. Voice channel equipment tests

All sub-carrier limiter readings for Division 4 were found to be close to or at full scale.

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